ACCESSION #: 9307210005
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Quad Cities Unit Two PAGE: 1 OF 09

DOCKET NUMBER: 05000265

TITLE: Reactor Scram From Turbine/Generator Trip
EVENT DATE: 06/13/93 LER #: 93-013-00 REPORT DATE: 07/13/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 4 POWER LEVEL: 57

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Jim Wethington, Station Support, TELEPHONE: (309) 654-2241
Mechanical Lead

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: EL COMPONENT: UK MANUFACTURER: G080
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: Yes EXPECTED SUBMISSION DATE: 07/01/94

ABSTRACT:

On June 13, 1993 at approximately 0624 hours, Unit 2 was in the RUN mode at 57% power when an internal electrical fault within the Unit 2 Main Power Transformer resulted in an automatic generator trip. The Main Turbine tripped and caused a reactor scram due to turbine stop valve closure. All safety features functioned as designed, however an unexpected Group I isolation occurred immediately following the turbine trip. An Emergency Notification System (ENS) call was completed at 0726(CST) on June 13, 1993, to comply with the requirements of 10CFR50.72(b)(2)(ii).

The transformer was determined to be damaged beyond repair and was replaced with a new ABB transformer. The Group I isolation was determined to be caused by pressure fluctuations caused by the rapid closure of the main stop valves following the turbine trip. A modification to eliminate the spurious Group I has been designed and is

scheduled to be implemented during Q2R13 and Q1R14.

LER265\93\013.WPF

END OF ABSTRACT

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power.

EVENT IDENTIFICATION: Reactor Scram from Turbine/Generator trip.

A. CONDITIONS PRIOR TO EVENT:

Unit: Two Event Date: June 13, 1993 Event Time: 0624
Reactor Mode: 4 Mode Name: RUN Power Level: 57%

This report was initiated by Licensee Report 265\93-013

RUN (4) - In this position the reactor system pressure is at or above 825 psig, and the reactor protection system is energized, with APRM protection and RBM interlocks in service (excluding the 15% high flux scram).

B. DESCRIPTION OF EVENT:

On June 13, 1993 at approximately 0624 hours, Unit 2 was in the RUN mode at 57% power when an internal electrical fault within the Unit Two Main Power Transformer(T2) [XFMR] resulted in an automatic turbine generator[TG] trip. The Main Turbine[TRB] tripped as expected and caused a reactor scram[JC] due to turbine stop valve[V] closure. As expected, reactor water level dropped after the scram and caused Group II and Group III containment isolations[JM], Reactor Building Ventilation isolation[VA], and Standby Gas Treatment System[BH] initiation. The lowest reactor water level reached during the event was -5".

Additionally an unexpected Group I isolation[JM] occurred less than a second after the main turbine trip. The Sequence of Events Recorder(SER)[IQ] indicated the Group I was caused by low mainsteam line pressure while in the RUN mode. The low pressure signal is believed to be a short duration pressure fluctuation caused by the rapid closure of the turbine stop valves.

The T2 differential relays[87] actuated due to the transformer fault causing the initiation of the T2 deluge system[KP]. This caused the autostart of both emergency fire diesel pumps[FP]. An Equipment Operator and Shift Foreman were sent to T2 to investigate. No external damage or fire was apparent and the deluge system was secured. A report of smoke in the Bus 25/26[EC] area was investigated and operators identified damage to an arrestor[LAR], a capacitor[CAP] and the enclosure located above the meter and relaying potential transformer[XPT] on the "A" phase of the Iso-phase bus[BDUC].

At 0629 the Group II and III isolations were reset and the Reactor Water Cleanup System[CE] was placed in service.

At 0630 the Group I isolation was reset. At 0645 the Main Steam Isolation Valves(MSIVs)[ISV] were reopened. This allowed the bypass valves to control reactor pressure.

At 0649 the Reactor Scram was reset. At 0656, the Shift Engineer ordered the initiation of a reactor cooldown at 50-80 degrees/hour. The Reactor [RCT] was placed in cold shutdown at 1520 on 6/13/93.

An Emergency Notification System (ENS) call was completed at 0726(CST) on June 13, 1993, to comply with the requirements of 10CFR50.72(b)(2)(ii).

Several minor problems were observed during the event. The 2B Feedwater Regulating Valve[LCV] locked up. The valve was able to be reset immediately by the Nuclear Station Operator(NSO). The 2D Drywell Cooler[VB] tripped and was subsequently restarted with no further problems noted. Also during review of the SER printout, several inconsistencies between expected and indicated relay operation were noted.

C. APPARENT CAUSE OF EVENT

This event is being reported in accordance with 10CFR50.73(a)(2)(iv) which requires the reporting of any event or condition that results in manual or automatic actuation of any Engineered Safety Feature(ESF), including the Reactor Protection System(RPS).

Transformer Failure

The cause of this event was equipment failure. The protective relay targets that were present following the turbine trip revealed a possible fault on both the high and low voltage windings on the Unit 2 main power transformer(T2). There were no protective relay targets present indicative of problems with the main generator or the Unit Auxiliary Transformer(UAT). Initially, a sample of the transformer nitrogen blanket was taken and analyzed. This sample showed elevated levels of combustible gasses which is an indication of internal arcing. A main transformer oil sample was also taken. The oil was black which also indicated an internal fault in the transformer because the oil is normally clear. Further chemical analysis revealed significant increases in all gas in oil measurements, most notably total dissolved combustible gas at 20,630 ppm, which was up from 55 ppm on 2/18/93. The transformer oil is routinely sampled approximately every six months. Sample results back to May, 1989 were reviewed. No trends that might have predicted this event were noted.

The protective relaying scheme operated as designed during the event. The additional relaying installed as part of the backfeed modification which was installed during Q2R12 also functioned properly and did not contribute to the event.

The history of this transformer was also reviewed. This transformer was the original Dresden 3 Main Power Transformer. The transformer failed at Dresden in 1978. The transformer was overhauled in 1979 by General Electric. The overhaul included rewinding the transformer core and the installation of internal flux shielding. A number of other changes were made to update the transformer to the General Electric standards of that time. The transformer was maintained as a spare until 1987 when it was installed at Quad Cities Unit 2.

The only operational problems associated with the transformer prior to the event involved the operation of the transformer fan banks. On 6/10/93, the system engineer noted that that the second bank of coolers was not running even though the transformer temperature was above the setpoint where the additional coolers should have auto started. The system engineer generated a work request(Q07937) to have the temperature relay reset to within the correct band. He

also contacted Operations and requested that the second cooler bank be placed in manual. In this mode the coolers operate continuously. Over the next two days the Transformer temperature decreased and reached a low of 37 degrees C just prior to the event. The lowest temperature reached was within the operating limits establish by QOS 005-S15(20-90 degrees C), however discussion with Station Electrical Engineering Department(SEED) personnel have indicated that operation below 40 degrees C is not desirable.

The Digital Fault Recorder(DFR) printout for the fault was reviewed by meter and relaying experts from Tech Center to determine a possible cause of the fault. The DFR review indicated a potential "A" phase fault and also indicated voltage present on the generator neutral which is an abnormal condition.

An arrestor and a capacitor were damaged in a compartment located above the meter and relaying potential transformer on the "A" phase of the Iso-phase bus. This resulted in a flashover from the bus connected to the arrestor to the cubicle door.

The transformer was meggered to test the winding resistance to ground. The test indicated that both the high and low side windings were unintentionally grounded.

The oil was drained from the transformer to support an inspection by SEED and General Electric (GE). The inspection team was able to determined that an "A" phase turn to turn high side fault had occurred. There was no visual indication of a high side to low side or low side to ground fault. A complete teardown inspection of the transformer will be performed. Pending completion of the inspection, the exact cause of the transformer fault and PT cabinet damage cannot be determined.

Group I Isolation

The system engineer performed a detailed review of the SER printout for this event and compared it to previous events where a turbine trip had preceded a spurious Group I. Based on this review, it was concluded that the isolation was caused by short duration pressure fluctuations caused by the rapid closure of the turbine stop valves.

SER Inconsistencies

During the investigation of the scram, two potentially significant anomalies were noted in the SER print out. The specific problems noted involved the indicated sequence of relay operation associated with RPS and the Primary Containment Isolation(PCI) Group I logic. In both cases, the recorded sequence of relay operation did not appear to be consistent with the design logic or the observed plant response. It should be noted that the discrepancies between the SER and the expected relay operation times were in the millisecond range. An investigation into the operation of the SER was conducted. The investigation concluded that the RPS and PCI logic functioned as designed during the event. The SER also functioned properly, however the timeline resolution of the system is limited by the design.

Review of a test conducted as part of that investigation did identify a control switch associated with the Group I isolation reset logic that was defective. The switch contact which resets the Group I seal-in circuit for the inboard MSIV isolation logic was sticking intermittently. When closed, this contact caused the seal-in logic for the inboard MSIVs to be bypassed and would have allowed the operator to reopen the inboard MSIV's without operating the reset switch. This problem would not prevent an isolation nor would it allow the operator to reopen the MSIV's with a valid isolation signal present.

2B Feedwater Regulating Valve Lockup

Instrument Maintenance(IM) performed troubleshooting under Nuclear Work Request Q05115. The dual low limiter, 2-640-47, which gives the Scram signal level setdown was checked for proper operation. The Master Level Controller, 2-640-18, was checked for low output. Output signal limiters were functioning properly. The controller's response, when the Scram setdown was simulated, tracked as expected, was repeatable and the output never fell below 9 mA. A few minor problems were identified during the IM troubleshooting, however none of the problems found would have caused an inadvertent FWRV lock-up.

Electrical Maintenance(EM) performed relay checks under Work Request Q08023. Several problems were identified while performing this work including binding, high contact resistance, and poor contact pressure with the 2-601-104 & 105 relays. Improper operation of

these relays likely led to the spurious FWRV lock-up.

2D Drywell Cooler Trip

The cause of the drywell cooler trip has not been identified. Based on review of the control logic, it is possible that the contactor for this motor experienced a momentary power loss during the Aux power transfer. A seal in contact in the logic would prevent the contactor from reclosing without operator action. A review of the history of this breaker indicated the preventative maintenance(PM) had been completed on January 29, 1992. The next scheduled PM was in 1996.

D. SAFETY ANALYSIS OF EVENT:

The safety consequences of this event were minimal. All expected ESF actuations occurred as designed to bring the reactor to a safe shutdown condition. The turbine stop valve closure scram occurs when the stop valves are less than 90% full open. This scram is intended to prevent exceeding the minimum critical power ratio (MCPR) safety limit by anticipating the rapid increase in pressure neutron flux, and heat flux which results from a fast closure of the turbine stop valves. If the turbine stop valve scram had failed, a reactor scram would have occurred from an Average Power Range Monitor (APRM) high neutron flux or high reactor pressure signal.

The operational problems noted did not have significant adverse impact on the operators ability to safely control the plant.

E. CORRECTIVE ACTIONS:

As immediate corrective action, the operating crew entered QGA 100, RPV Pressure and Level Control, and placed the plant in a safe and stable condition. Operator response to the event was considered appropriate.

Main Transformer

The main transformer was determined to be damaged beyond repair. Exempt Change E04-2-93-132 was issued to replace the main power transformer with a new ABB transformer. The replacement was performed by Electrical Maintenance and Substation Construction and tested by OAD and Tech Staff.

A new fire suppression and detection system was installed due to the change in physical lay-out of the transformer under Exempt Change

E04-2-93-137. This was installed by SWEC and Electrical Maintenance and was tested by OAD, Tech Staff, and the station Fire Marshall.

The arrestor and capacitor located above the meter and relaying potential transformer on the "A" phase of the Iso-phase bus were replaced under Work Request Q07955 by the electrical maintenance department. Arrestors on the "B" and "C" phases were also replaced as a preventative measure. The cubicle door and back wall were replaced and the interior was cleaned.

The generator lead boxes were opened and inspected by GE, SOAD, and Tech Staff. No evidence of damage due to the fault existed. The generator stator was meggered showing 2.3 meg ohms. The lead box covers were replaced and checked for leakage.

A megger, transformer turns ratio test, DC resistance and low voltage excitation tests were performed on Transformer 21 and revealed no abnormalities. Test data was comparable to that obtained in May, 1993 after minor transformer repairs had been completed.

A crawl through inspection was performed on all of the iso-phase bus connecting the main transformer to the generator revealing no additional damage. A megger and a DC Hi-pot test were performed on the iso-phase bus revealing no abnormalities.

A through-fault test was performed on the electrical system to verify proper relay actuation during high side and low side fault conditions.

A complete teardown of the transformer will be performed. Upon completion of the inspection a supplemental report will be issued (NTS# 2651809301301).

To address the question of transformer cooler operation the system engineer will work with the appropriate company departments to evaluate cooler operational settings and limits (NTS# 2651809301302).

Group I Isolation

Modification M04-1(2)-92-019 had been designed prior to this event to prevent the occurrence of a spurious Group I isolation following

a turbine trip. This Modification is scheduled to be installed during outage periods Q2R13 and Q1R14. The priority assigned to this modification will reevaluated by the Station Modification Review Committee. (NTS# 2651809301303).

2B Feedwater Regulating Valve Lockup

Troubleshooting was performed by the Electrical and Instrument Maintenance. Two relays were not operating properly and they were replaced. Improper operation of the relays likely led to the spurious FWRV lock-up. Work Request Q08403 was completed to check the corresponding U-1 relays. The Unit 1 relays had high contact resistance and were cleaned and adjusted.

The Feedwater System Engineer will review the maintenance history of the relays associated with the Feedwater control system and recommend preventative maintenance as appropriate. (NTS# 2651809301304).

SER Inconsistencies

An interim Procedure was written to evaluate the operation of the SER. Although not directly associated with the event, this procedure identified a problem with the Group I Isolation Reset switch. The Electrical Maintenance Department replaced the defective switch under Work Request Q08427.

2D Drywell Cooler

Work request Q07956 was written to investigate the trip of the 2D Drywell Cooler (NTS# 2651809301305).

F. PREVIOUS EVENTS:

There have been two previous events since 1987 at Quad Cities Station where a transformer problem has initiated a reactor scram. These events are documented under the following Licensee Event Reports:

LERS DESCRIPTION

265/87-009 Scram Caused By Turbine/Generator Load Reject Due to a Main Transformer "C" Phase Fault

265/87-005 Unit Two Turbine Generator Trip/Reactor Scram Due to Spurious Actuation of Transformer Two Sudden Pressure Relay

There have been six previous documented events where a spurious Group I isolation occurred subsequent to a turbine trip/reactor scram. It was found that the spurious Group I PCIs only occurred when a turbine trip caused a reactor scram(i.e. Turbine Main Stop Valves closed first). An unexpected Group I has not been noted when a reactor scram precedes the turbine trip. The six previous events are documented under the following Licensee Event Reports:

LERS DESCRIPTION

265/92-001 U2 Reactor Scram During Turbine Trip Test

254/91-025 Reactor Scram Due to Turbine Trip from Rx High Water Level Due to 1A FRV Failing Full Open

265/90-010 U2 Reactor Scram Due to Turbine Trip from 2C Moisture Separator High Level

254/89-010 Reactor Scram from an Induced Voltage Due to a Loose Wire on the Condenser Low Vacuum Pressure Switch

265/89-001 Turbine Trip - Reactor Scram While Testing Master Trip Solenoid

265/88-005 U2 Reactor Scram Due to Feedwater Regulating Valve Packing Failure

G. COMPONENT FAILURE DATA:

Manufacturer Nomenclature Model Number Part Number

General Electric Unit 2 Main Power Class FOA SN# D590594 Transformer 17.1/345KV (SI 161811)

General Electric Lightning Arrestor Alugard 9L11LAB (SI 167158)

General Surge Protection 9L18
Electric Capacitor (SI 167384)

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ATTACHMENT 1 TO 9307210005 PAGE 1 OF 1

Commonwealth Edison
Quad Cities Nuclear Power Station
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Cordova, Illinois 61242-9740
Telephone 309/654-2241

RLB-93-097

July 13, 1993

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Reference: Quad Cities Nuclear Power Station
Docket Number 50-265, DPR-30, Unit Two

Enclosed is Licensee Event Report (LER) 93-013, Revision 00, for Quad Cities Nuclear Power Station.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(iv). The licensee shall report any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature.

Respectfully,

COMMONWEALTH EDISON
QUAD CITIES NUCLEAR POWER STATION

R. L. Bax
Station manger

RLB\TB\plm

Enclosure

cc: J. Schrage
T. Taylor

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